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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/885,943	06/22/2001	Takashi Udagawa	Q61743	6215

7590 11/14/2002

SUGHRUE, MION, ZINN, MACPEAK & SEAS, PLLC
2100 Pennsylvania Avenue, N.W.
Washington, DC 20037-3213

EXAMINER
MONDT, JOHANNES P

ART UNIT	PAPER NUMBER
2826	

DATE MAILED: 11/14/2002

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No. 09/885,943	Applicant(s) UDAGAWA, TAKASHI
	Examiner Johannes P Mondt	Art Unit 2826

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE ____ MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *04 September 2002* .

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1,4,5,10-12 and 14-21* is/are pending in the application.

4a) Of the above claim(s) *16-21* is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1,4,5,10-12,14 and 15* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

11)☐ The proposed drawing correction filed on _____ is: a)☐ approved b)☐ disapproved by the Examiner.

If approved, corrected drawings are required in reply to this Office action.

12)☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

13)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☒ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____ .

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

14)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).

a) ☐ The translation of the foreign language provisional application has been received.

15)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____ .
4) ☐ Interview Summary (PTO-413) Paper No(s). _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: .

DETAILED ACTION

Drawings

The corrected or substitute drawings (four sheets including Figures 1, 2, 3, 4, 5, and 6) were received on 09/04/2002. The objections to drawing of figure 5 is herewith withdrawn.

Response to Amendment

Amendment A filed 09/04/2002 and filed as Paper No. 8 forms the basis of the present office action. In Amendment A, Applicant canceled claims 2, 3, 6-9 and 13, and substantially amended the only remaining independent claim (claim 1). Please see "Response to Arguments" for comments on Remarks by Applicant in said Amendment A in as far as they pertain to the present claim set.

Response to Arguments

1. Applicant's arguments filed 09/04/2002 have been fully considered but they are not persuasive. The claim language has been substantially changed by Amendment A. This holds for all pending claims. As shown by Terashima et al (6,069,021), a first boron phosphide buffer layer composed of amorphous boron phosphide followed by a monocrystalline second boron phosphide buffer layer has long been recommended in the art of Group III nitride semiconductor crystal layer growth methods for (inter alia) light-emitting layers (see title, abstract and column 1, lines 35-40) for the specific purpose to relieve strain relative to the underlying monocrystalline substrate by the insertion of the amorphous buffer layer; see column 4, lines 47-60. Moreover, the motivation carries over to Hatano et al, because the need for the amorphous first boron

phosphide buffer layer stems from the discrepancy between the lattice constants between boron phosphide (4.59 Å) and the underlying substrate, which in the case of Hatano et al is gallium phosphide with a lattice constant of 5.45 Å (see Sze, S.M., page 537 of Appendix F) and in the case of Terashima et al is silicon with a lattice constant of 5.43 Å (see Sze, S.M., page 537 of Appendix F), said discrepancy thus being essentially the same in the two cases to within a relative error bar of about 2%. Also, in both cases vapor deposition is the method of making and so the teaching by Terashima et al also combines methodically. In view of the long-developed experience with vapor phase growth methods success in the implementation can be reasonably expected. The new claim set can therefore not be allowed.

Claim Rejections - 35 USC § 103

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

2. ***Claims 1 and 5*** are rejected under 35 U.S.C. 103(a) as being unpatentable over Hatano et al (5,042,043) in view of Kawai (JP411045892A) and Terashima et al (6,069,021).

Hatano et al teach (front figure and title and abstract; in the latter on line 5 select the sub-range by selecting y=0 (no Al), and x=1 (no B); whereupon for future reference we shall adopt the notation of Applicant and denote the parameter "1-z" in Hatano et al

by "x") a group III nitride semiconductor light-emitting device comprising a substrate 11 (column 4, lines 25-27) having thereon a light-emitting part structure comprising a gallium nitride phosphide single crystal layer 15 (column 4, lines 28-30) provided via a boron phosphide based buffer layer 13 (column 4, line 33). Hatano et al do not teach the said substrate to be a single crystal; however, Kawai teaches that for enhancing hardness and stability a single-crystal substrate is to be used in semiconductor light-emitting devices (see in English abstract, "Problem to be Solved"). Desirability of hardness and stability provides motivation; the inventions can be easily combined, as all that needs to be done is to select a single-crystal substance for the substrate material of choice.

Although neither Hatano et al nor Kawai necessarily teach the further limitation that the boron phosphide buffer layer should "comprise a multi-layer structure including an amorphous layer and a crystalline layer formed on the amorphous layer, both the amorphous layer and the crystalline layer being formed of the same material", it would have been obvious to include this further limitation in view of Terashima et al, who teach a first amorphous boron phosphide layer on top of a crystalline substrate of substantially the same amount of lattice mismatch with boron phosphide as the substrate in the invention by Hatano et al, followed by a crystalline (single crystal) boron phosphide layer for the specific purpose of providing in a method to grow a Group III nitride semiconductor crystal structure relief from a lattice mismatch between the boron phosphide buffer layer and the underlying substrate. See column 4, lines 47-57. Please note that the lattice constant mismatch between silicon (5.43 Å) and boron phosphide

(4.54 Å) (Terashima et al) is substantially the same as between gallium phosphide (5.45 Å) and boron phosphide (Hatano et al), as the lattice constants of gallium phosphide and silicon differ only by about 2% of the difference in the lattice constant between either silicon or gallium phosphide with the lattice constant of boron phosphide (4.54 Å). Therefore, the *motivation* for inserting the amorphous layer as explicitly taught by Terashima et al carries over to Hatano et al. The teaching by Terashima et al can be *combined* at least because of the long-standing experience with implementing amorphous layers through vapor phase methods as the ones employed by both Hatano et al and Terashima et al. *Success* in the implementation of the combination of the inventions in this regard can therefore be reasonably expected.

With regard to claim 5: The device taught by Hatano et al comprises a double hetero-junction structure as light-emitting part structure (see heterojunctions between layers 14 and 15, and between 15 and 16 (cf. column 4, line 35).

3. ***Claim 4*** is rejected under 35 U.S.C. 103(a) as being unpatentable over Hatano et al, Kawai and Terashima et al as applied to claim 1 above, and further in view of Liu et al (5,612,551).

Neither Hatano et al nor Kawai nor Terashima necessarily teach the further limitation of claim 4. However, Liu et al teaches a single hetero-junction structure as light-emitting part of a light-emitting device for the purpose of making it unnecessary to use bandgap engineering to cope with the conduction band discontinuity between the light-emitting and collector layers (cf. column 1, lines 58-62). The problem exists also for Hatano et al,

considering the discontinuity between the conduction bands of BP and $GaN_{1-x}P_x$. Hence the teaching of Liu et al is relevant. The teachings can be combined, as all that is necessary is to remove enough hetero-junctions. Success can be reasonably expected as this removal does not interfere with the remainder of the teaching by Hatano et al, Kawai and Terashima et al.

4. ***Claim 10*** is under 35 U.S.C. 103(a) as being unpatentable over Hatano et al, Kawai and Terashima et al as applied to claim 1 above, and further in view of Doll (5,326,424). Neither Hatano et al nor Kawai nor Terashima et al necessarily teach the further limitation defined by Applicant's claim 10. However, it is entirely obvious to limit the range of the stoichiometric parameter x defining the phosphorus concentration ratio ("compositional ratio") in the gallium nitride phosphide single crystal layer to maximally about 6% in view of the impossibility to raise the lattice constant of the underlying boron nitride phosphide buffer layer over the upper limit of the range indicated by Doll et al: no amount nor any lack of amount, of nitrogen or phosphorus in said boron nitride phosphorus buffer layer can be selected to achieve lattice matching for values of x for which the lattice constant of the gallium nitride phosphide single crystal layer exceeds that of boron phosphide. Therefore, the further limitation of claim 10 is inherently met under conditions defined by claim 1.

5. ***Claim 11*** is rejected under 35 U.S.C. 103(a) as being unpatentable over Hatano et al, Kawai, Terashima et al and Liu et al as applied to claim 4 above, and further in

view of Doll et al (5,326,424). As detailed above, claim 4 is unpatentable over Hatano et al in view of Kawai, Terashima et al and Liu et al. Neither Hatano et al nor Kawai nor Terashima et al nor Liu et al necessarily teach the further limitation as defined by claim 11. However, as we have seen from the discussion of claim 7, it is entirely obvious to limit the range of the stoichiometric parameter x defining the phosphorus concentration ratio ("compositional ratio") in the gallium nitride phosphide single crystal layer to maximally about 6%, - hence comprising substantially the range indicated in Applicant's claim, in view of the impossibility to raise the lattice constant of the underlying boron nitride phosphide buffer layer over the upper limit of the range indicated by Doll et al: no amount nor any lack of amount, of nitrogen or phosphorus in said boron nitride phosphorus buffer layer can be selected to achieve lattice matching for values of x for which the lattice constant of the gallium nitride phosphide single crystal layer exceeds that of boron phosphide. The further limitation of claim 11 is thus inherently met in the condition described by claim 4.

6. ***Claim 12*** is rejected under 35 U.S.C. 103(a) as being unpatentable over Hatano et al, Kawai, and Terashima et al as applied to claim 5, respectively, above, and further in view of Doll et al (5,326,424). Neither Hatano et al nor Kawai nor Terashima et al necessarily teach the further limitation as defined by claim 12. However, as we have seen from the discussion of claim 7, it is entirely obvious to limit the range of the stoichiometric parameter x defining the phosphorus concentration ratio ("compositional ratio") in the gallium nitride phosphide single crystal layer to maximally about 6% in view

of the impossibility to raise the lattice constant of the underlying boron nitride phosphide buffer layer over the upper limit of the range indicated by Doll et al: no amount nor any lack of amount, of nitrogen or phosphorus in said boron nitride phosphorus buffer layer can be selected to achieve lattice matching for values of x for which the lattice constant of the gallium nitride phosphide single crystal layer exceeds that of pure boron phosphide. Therefore, the further limitation of claim 12 is inherently met under conditions defined by claim 5.

7. ***Claims 14 and 15*** are rejected under 35 U.S.C. 103(a) as being unpatentable over Hatano et al, Kawai and Terashima et al as applied to claim 1 above, and further in view of Isokawa et al (6,121,637). Neither Hatano et al nor Kawai nor Terashima et al necessarily teach the further limitations defined by either claims 14 and 15. However, the very purpose of the invention essentially taught by Hatano et al is the construction of a lamp or light source comprising the lamp, as can be gleaned from the abstract and "Field of Invention" sections in Hatano et al (cf. abstract, line 1 and column 1, lines 8-10) and as can be learned from a multitude of patents and journal publications, for instance Isokawa et al, who teach a light-emitting device (hence lamp and light source) based on a Group III-V semiconductor light-emitting element comprising a mount lead 12 and an inner lead 11 (cf. Figure 3 (a) and column 6, lines 53-61).

Conclusion

8. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Johannes P Mondt whose telephone number is 703-306-0531. The examiner can normally be reached on 8:00 - 18:00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nathan J Flynn can be reached on 703-308-6601. The fax phone numbers for the organization where this application or proceeding is assigned are 703-308-7722 for regular communications and 703-308-7724 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703-308-0956.

JPM
November 10, 2002

NATHAN J. FLYNN
SUPERVISORY PATENT EXAMINER
TECHNOLOGY CENTER 2800